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(56) Documents cited
GB 2226888 A GB 2219864 A GB 2213943 A
EP 0036935 A1 US 4823075 A

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(54) Current sensing device

(57) A current sensing device (2) in an integrated circuit comprises a Hall effect device (4) on a substrate (6) and surrounded by a coil (8) which carries the current to be sensed. A second Hall effect device (10, Figure 2 not shown) may be positioned near the first device to monitor changes in the background magnetic field. Further sensing devices may also be incorporated (Figures 3, 4 not shown).

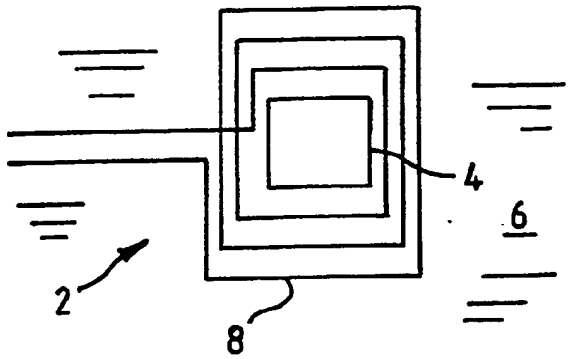

FIG.1

GB 2 255 645 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

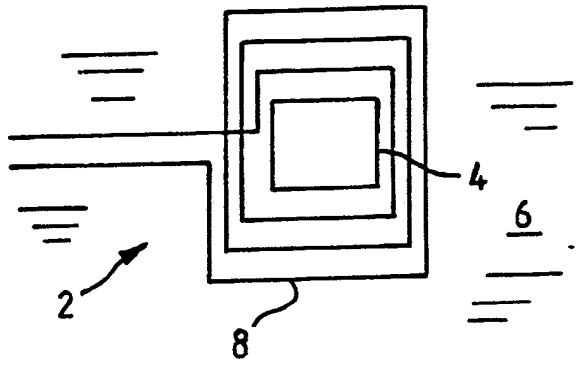

FIG.1

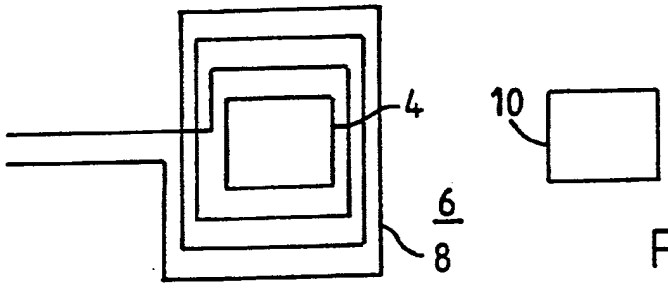

FIG.2

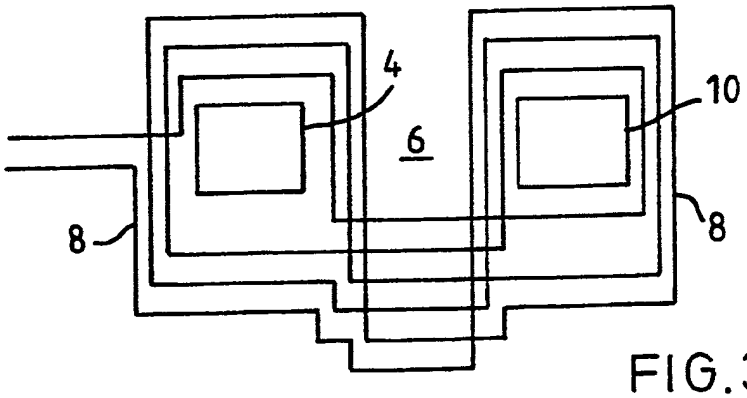

FIG.3

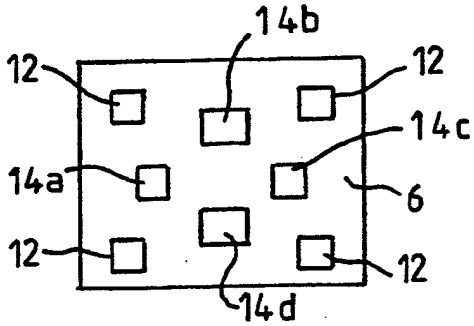

FIG.4

CURRENT SENSING DEVICE

The present invention relates to a current sensing device, and in particular to a current sensing device in an integrated circuit, such as a thin-film or thick-film device, a semiconductor device, or the like.

Typically a current is detected or measured by passing it through a resistor and detecting or measuring the voltage drop across the resistor.

The present invention provides a current sensing device in an integrated circuit, the device comprising a Hall effect device and a coil, the current to be sensed being passed through the coil to induce a magnetic field in the vicinity of the Hall effect device, whereby the Hall effect device provides an indication of the current.

The coil is positioned so that the anticipated current level will induce a measurable change in magnetic flux in the sensor. Very preferably the coil surrounds the sensor.

The sensing device may be arranged to sense a change in current level and/or to indicate an absolute current value.

In order to reduce effects caused by changes in the background magnetic field, a second Hall effect device may be positioned close by the first device to respond to changes in the background field to provide a reference level.

To increase sensitivity of the current sensing device, the current may also be passed through a coil surrounding the second Hall effect device.

In another preferred embodiment of the invention, an array of Hall effect devices are each surrounded by respective coils, for detecting currents in the respective coils, and a second array of Hall effect devices is provided about the first array to provide an estimation of the background magnetic field at the positions of the Hall effect devices in the first array.

A current sharing resistor may be provided to reduce the level of current flowing through the coil(s).

Other preferred features and advantages of the invention

will be apparent from the following description and the accompanying claims.

The invention will be further described by way of example with reference to the accompanying drawings, in which:

Figure 1 illustrates a first embodiment of a current sensing device in accordance with the invention;

Figure 2 illustrates a second embodiment of the invention;

Figure 3 illustrates a third embodiment of the invention; and

Figure 4 illustrates a fourth embodiment of the invention.

Figure 1 illustrates a first embodiment of a current sensing device 2 according to the invention. A Hall effect device 4 is formed in or on the surface of a silicon substrate 6 of an integrated circuit. A coil 8 is formed by laying an electrically conductive metal track about the device 4. A direct current to be monitored is fed through the coil 8, which will create a magnetic field across the Hall effect device 4 in proportion to the current flowing. The signal induced in the Hall effect device is monitored and can be used to provide a measure of the magnitude of current or a

change in the current in the coil 8. Where the current to be monitored is high, a low resistance sense resistor is provided in parallel with the coil to reduce the current flowing in the coil and avoid overheating of the coil track.

The embodiment of Figure 1 may be applied, for example, in a circuit for sensing a bulb failure and provides a sensing device which will drain very little power from the circuit.

In the embodiment of Figure 2, a second, compensating Hall effect device 10 is formed adjacent the device 4. The device 10 is used as a reference point to cancel out the effects of any changes in the background magnetic field.

In the embodiment of Figure 3, the second device 10 is also surrounded by the coil 8, but with the turns going in the opposite direction. Thus the total magnetic field created by the current to be sensed is effectively doubled, and any changes in the background magnetic field are automatically compensated for.

The close proximity of the Hall effect devices in the embodiments of Figures 2 and 3 should result in adequate

compensation for variations in the background magnetic field. The embodiment of Figure 4 illustrates schematically a system in which four Hall effect devices 12 are placed at the corners of a square to monitor the background magnetic field and four devices 14a,b,c,d are placed within the square and surrounded by respective coils (not shown) to monitor the current flowing in the coils. The signals generated in each of the devices 12 are summed according to a simple algorithm to calculate the background magnetic field at the respective devices 14.

Various modifications may be made to the described embodiments and it is desired to include all such modifications as fall within the scope of the accompanying claims.

CLAIMS

1. A current sensing device in an integrated circuit, the device comprising a Hall effect device and a coil, the current to be sensed being passed through the coil to induce a magnetic field in the vicinity of the Hall effect device, whereby the Hall effect device provides an indication of the current.

2. A device as claimed in claim 1, wherein the coil surrounds the Hall effect device.

3. A device as claimed in claim 1 or 2, wherein a second, compensating Hall effect device is provided near the the first said Hall effect device to compensate for changes in background magnetic field.

4. A device as claimed in claim 3, wherein coils are associated with both Hall effect devices, the coils being oppositely wound and the current to be sensed being passed through both coils to induce a magnetic flux of opposite sense in each Hall effect device.

5. A device as claimed in claim 3, comprising a plurality of compensating Hall effect devices, the compensating devices being positioned about the first

said Hall efffect device, and means for summing the signals from the compensating devices to estimate the background magnetic field at the first device.

6. A device as claimed in claim 5, wherein a plurality of first decvices is provided.

7. A current sensing device substantially as hereinbefore described with reference to Figure 1, 2, 3 or 4 of the accompanying drawings.

8. An integrated circuit including a current sensing device as claimed in any one of claims 1 to 6.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number 9110103.0

Relevant Technical fields

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(ii) Int Cl (Edition 5) G01R 15/02 19/00; H01L 43/00

Search Examiner

K F J NEAL

Databases (see over)

(i) UK Patent Office

(ii)

NONE

Date of Search

5 August 1991

Documents considered relevant following a search in respect of claims 1-8

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2226888 A (FUJI) (Figure 3a)	1
X	GB 2219864 A (STANLEY) (Note lines 20-24 page 4)	1,8
X	GB 2213943 A (YORKSHIRE) (Figure 1)	1
X	EP 0036935 A1 (IBM) (Note lines 19-28 page 12)	1,8
X	US 4823075 A (ALLEY) (Note claim 3)	1,2,8

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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